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WADD TECHNICAL REPORT 60-750

**EFFECTS OF REPETITIVE EATING OF LIMITED GROUPS OF  
FOOD ITEMS ON FOOD ACCEPTANCE**

*Quartermaster Food and Container Institute  
for the Armed Forces  
Chicago, Illinois*

*Quartermaster Research and Engineering Command  
U. S. Army  
U. S. Air Force*

**DECEMBER 1960**

MIPR No. 33(616) 59-19

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AEROSPACE MEDICAL LABORATORY  
WRIGHT AIR DEVELOPMENT DIVISION  
AIR RESEARCH AND DEVELOPMENT COMMAND  
UNITED STATES AIR FORCE  
WRIGHT-PATTERSON AIR FORCE BASE, OHIO

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Project No. 7164  
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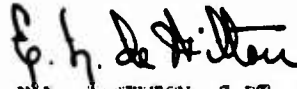
## FOREWORD

The research in this report was accomplished by the Quartermaster Food and Container Institute for the Armed Forces under Military Interdepartmental Purchase Request No. 33 (616) 59-19, Project No. 7164, "Physiology of Flight," Task No. 71833, "Nutrition in Flight," for the Aerospace Medical Laboratory of the Wright Air Development Division. The principal investigators were Dr. Joseph M. Kamen and Mr. David R. Peryam. The experimental phase of the research was conducted by the Food and Containers Engineering Branch, Quartermaster Research and Engineering Field Evaluation Agency, Mr. Elie Weeks, Branch Chief, and Mr. Thomas Burt, Military Analyst. Miss Beatrice Finkelstein, Biospecialties Section, Physiology Branch, Biomedical Laboratory, Aerospace Medical Laboratory, served as contract monitor.

## ABSTRACT

The effects of the type of menu planning, and the number of different foods on food preferences and consumption are discussed. Seventy-two volunteers were assigned randomly to three 24-day feeding treatments: (a) 3-day, preplanned, fixed-menu cycle, all meals in the same sequence; (b) 6-day, preplanned, fixed-menu cycle, same foods as above plus an approximately equal number of new foods; and (c) 3-day cycle, same foods as (a) but, after first 3 days, men planned their own menus. The foods, mainly canned or dehydrated, were from military and commercial sources. Experimental items, including a high-protein beef drink, high-calorie, high-protein chocolate drink, and coffee drink, were also served. The over-all satisfaction with (b) and (c) was about equal and higher than with (a).

## PUBLICATION REVIEW



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Effects of Repetitive Eating of Limited Groups of Food  
Items on Food Acceptance

SECTION I

INTRODUCTION

An increase in the efficiency of a feeding system might be achieved by very frequent repetition of the menu components. However, this possibility must be balanced against the adverse behavioral effects of a restricted dietary. Knowledge of the relationship of repetition and change in food preference and consumption is essential in achieving the goal of maximum operational efficiency with a minimum of negative changes in behavior. Such considerations involve logistic consequences since the number of items that must be supplied for the success of a military operation determine, in part, logistic efficiency.

These deliberations take on additional importance in the case of food items proposed for development or currently under development. Questions arise as to whether it is more advantageous to concentrate effort on a few items of outstanding quality or on many items of lesser quality, or whether canned foods generally produce monotony effects at faster or slower rates than dehydrated foods.

As manned high-altitude flights become of longer duration, the problems of food monotony increase. While special semisolid foods are being developed for this purpose, there are many commercially available foods and components of existing operational rations that might also be suitable. Testing these foods "on-the-ground" for suitability in such different environments would certainly provide an ambiguous answer. Nevertheless, this testing could serve as a screening device on the assumption that failure "on-the-ground" is likely to foretell failure at high altitudes, even though success "on-the-ground" might not necessarily imply acceptability under markedly altered environmental conditions.

One more aspect of repetitive feeding which requires elaboration is that, in future warfare, soldiers will operate in large part as members of small and perhaps relatively isolated groups. This situation offers the opportunity to devise new concepts and methods of feeding that may be expected to increase acceptability of frequently consumed foods. A hypothesis appearing worthy of investigation, since it conforms to general psychological principles, is having groups of men do their own menu planning from a fixed list of components. This will be more effective in lessening monotony than menus planned by others.

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Empirical studies in this area have been few, and none of these have used experimental variations. In one study reported by Siegel and Pilgrim (6), 79 college men subsisted for 22 days on two alternate daily menus consisting of canned operational ration components. Among the conclusions of the study were: practically all foods declined in consumption and preference with repetitive eating and there was little, if any, recovery with the passage of time; items having an initially high rating generally showed less decline in rating than items rated low initially; the rate of decline was partly a function of the specific food. Similar conclusions were reached by Schutz and Pilgrim (5) in another study of soldiers who were limited to 41 different canned operational ration items for 37 days. Apart from these two studies and minor questionnaire investigations on desired frequency of serving, evidence has been almost nil. Instead, speculation and unsupported opinions have been bountiful.

In view of the importance of and lack of knowledge about repetitive feeding, experimental investigation of this problem becomes important. Two variables appear especially worthy of exploratory study: cycle length, one of the most pressing, and self- vs. other-planning of menus. Since, in future combat, soldiers may be expected to exist in small, relatively isolated groups involving greater interdependency among the group members, greater acceptance of the rations might be achieved by allowing the meals to be "custom designed" to the unique menu combination preferences of each group.

Thus, the purpose of this study is:

1. To evaluate the effects of a restricted dietary upon food consumption and preference, more specifically, to compare 3- vs. 6-day menu-cycle lengths over a period of 24 days.
2. To determine the psychological advantages and disadvantages of menu planning by the consumers themselves in comparison to menus devised by others.
3. To estimate the monotony characteristics of certain foods, especially canned and precooked dehydrated.

## SECTION II

### METHODS AND MATERIALS

Seventy-two enlisted personnel from permanent units of the Quartermaster Group at Fort Lee, Virginia, volunteered as subjects. The duration of the test was 24 consecutive days, from 5 through 28 October 1959. One subject from each experimental treatment dropped out before the test was completed, 2 because of separation from service, and 1 because of hospitalization for causes not related to the test.

Physical Well-Being. Subjects were weighed 3 days prior to the start of the test and every 6 days thereafter. Individual interviews were conducted at the conclusion of the experiment to determine whether subjects experienced gastrointestinal disturbances, headaches, or other physical ailments during the experiment.

Background Questionnaire. A questionnaire was administered a few days prior to the test, on background information of each subject (age, education, etc.) and on his attitude toward the Army and toward the test.

Summary of Responses. (See Appendixes C-1 and C-2.) Two main sections were included in the final questionnaire, administered on the day after the test was completed:

I. Food Evaluation. The nine subdivisions comprised evaluation of the suitability of the foods and menus, and a request for recommendations.

II. Personal Reactions. Seven questions dealt with the attitude of the subjects toward the test, whether they consumed any foods or beverages not authorized, and their physical conditions at various intervals during the experiment.

Consumption Preference. After every meal and the evening snack, each subject indicated how much, to the nearest one-third of a portion, he ate of each food served and how much he liked it (4). Observer-recorders checked the sheets for accuracy in estimating amount consumed.

The general activity level was slight to moderate. The men participated in organized athletics and physical training and were assigned to routine work details. Several commented on the insufficient physical exercise.

Components of the In-Flight 9 Ration. These foods were similar to the ones used in the Meal, Combat, Individual (2). The bread was replaced with a better quality canned bread with sorbitol.

Precooked Dehydrated Items. All components, with the exception of chili and beans, of the 3-day cycle of Quick Serve Meals (7) were used in at least one experimental treatment. In addition, precooked dehydrated shrimp was procured. For the most part, these items were specially packed from bulk into 6-man modules.

Commercially Available Foods. Soups, candy bars, vegetables, and others were included.

Experimental Foods. High-protein, high-calorie chocolate and coffee drinks previously found suitable for hospital feeding (1) were also served. The instant dry powder for the chocolate drink consisted of 87.64 percent dry whole milk, 8.30 percent sugar, 2.30 percent cocoa, 1.53 percent vanilla sugar, and 0.23 percent instant coffee. The coffee drink was the same except for a three-fold increase in coffee. Also supplied to one treatment (6-day cycle) was a beef drink, a semisolid consisting largely of a mixture of tomato juice and commercial baby food beef, plus seasonings (3).

Food Types. Four types of foods were served. The types of foods and number of times served per cycle are listed in Appendix A.

#### Menus

One 3-day cycle and one 6-day cycle were devised from the available components as listed. In each day of a cycle, there were the three usual meals plus an evening snack.

The 6-day cycle contained about twice the number of different foods as did the 3-day cycle. In each cycle, any main dish, soup, or vegetable was served only once. Starches and processed fruits were sometimes served more than once during a cycle, although the approximate 2-to-1 ratio of different foods for the two cycle lengths was still preserved.

The proportion of dehydrated to canned to commercial foods was also approximately the same for the two cycle lengths. The number of calories per daily menu varied from 3300 to 4500 per man with an average of about 4000.

The 3- and 6-day menus are shown in Appendix B.

#### Experimental Treatments

Twenty-four subjects were randomly assigned to each of three experimental treatments and, in turn, assigned to four 6-man groups, in each treatment.

Treatment 1: Three-day cycle, self-planning of menus. During the first cycle only, subjects were served the menus shown in Appendix B-1 in order to familiarize them with the foods available. Menus for all succeeding cycles were planned by each 6-man group separately, using the same foods and in the same quantities as in the first cycle. In effect, planning enables them to choose the combinations most preferable. The menus could be different in each of the 7 self-planned cycles.

Treatment 2: Three-day cycle, preplanned menus. Groups in this treatment subsisted on the menus as listed in Appendix B-1. All menus were repeated in toto from cycle to cycle so that, for example, Breakfast No. 1 was always served on days 1, 4, 7, 10, etc., and Dinner No. 3 was always served on days 3, 6, 9, 12, etc.

Treatment 3: Six-day cycle, preplanned menus. This treatment was similar to treatment 2, except for the greater number of different foods and, thus, a longer cycle. (See Appendix B-2.)

Each treatment group was provided with its own barracks and a fully equipped mess hall. Except for food-related activities, there was no segregation of the 6-man subgroups within the larger treatment group.

The men prepared their own foods except for the beef link and the shrimp sauce which required trained cooks. Instruction sheets for preparing each item were provided. Trained cooks were always available to furnish advice, although they did not prepare the foods. Initially, different sets of 3 men from each subgroup were assigned, meal by meal, to prepare the foods. This number was excessive and was reduced to 2 after the first cycle. In many cases, one man was sufficient.

### SECTION III

#### RESULTS

##### Physical Well-Being

Weight Changes. Almost as many lost weight as gained, the over-all effect being no change. The differences, however, can be attributed to chance fluctuations.

Illness. Thirty-nine of the 69 respondents reported no illness of any type. Of the remaining 30, 13 said they had headaches or digestive disturbances that occurred only once and lasted a day or less, or that they had an illness not attributable to the dietary (e.g., dental trouble, reaction to flu shot, etc.). Seventeen did report headaches or digestive disturbances that occurred more than once or lasted more than 1 day, and 6 of these said they also had another type of illness. Note that 11 of the 17 were from treatment 1 (3-day, self-planned), and 6 of these were from one subgroup. The concentration of reports of illness may be due to particular individuals in a treatment and subgroup "suggesting" illnesses to their comrades, or perhaps to the effect of less well-balanced meals resulting from self-planning. In any case, severe adverse effects on health were not demonstrated.

The constancy of body weight and the low incidence of illnesses, particularly for the second and third treatments, suggest that the dietary is suitable from the point of view of physical well-being. Had illness rates of those subsisting on the normal A Ration been available for comparison, firmer conclusions could be drawn.

##### Background Questionnaire

The median age was about 21 and the average education was about third year of high school. About 84 percent had had between 6 and 18 months of Army service. The median size of town in which subjects resided before they were 16 years old had a population of 2,500 to 25,000 people. Over 80 percent did not ask for assignment to Fort Lee. They were about equally divided in preferring an overseas assignment to remaining in the United States. All but 9 considered their morale on the high side, and all but 10 had some degree of

favorable attitude toward the Army. No one was displeased about participating in the test, although 6 said they did not care one way or the other. Twenty-one characterized their physical condition as excellent, 38 as good, 9 as fair, and 1 as poor.

No significant differences were found from treatment to treatment on any item in this questionnaire. There was a trend (not statistically significant) for those in treatment 2 (3-day, preplanned) to have a slightly lower level of morale.

#### Summary of Responses

a. Food Evaluation. The subjects of treatment 2 (3-day, preplanned) considered the rations significantly less satisfactory ( $p < 0.01$ ) for continuous use in the field for two months than did the men in the other two treatments. The difference between the 3-day, self-planned, and the 6-day, preplanned treatments was not significant. The data also suggests that more subjects in the self-planning treatment than in the other 2 treatments were in favor of leaving the ration as it is. Similarly, the self-planning subjects thought they could live longer on this ration with no other food than did the other subjects ( $p < 0.01$ ) (Appendix C-1).

Thus, it appears that the most dissatisfied subjects were those assigned to the shorter cycle and preplanned menus. Self-planning induced beliefs that soldiers should be expected to subsist on this type of ration for a longer time. One might conclude that self-planning does as much to increase satisfaction with the ration as does doubling the number of different foods, and extends the period within which subjects believe men should be expected to subsist on them.

However, increasing the number of foods does appear to reduce desire for other foods not provided. This is shown by the fact that significantly fewer ( $p < 0.05$ ) subjects in the 6-day cycle treatment developed strong desires or cravings for foods that weren't available: 22 percent in the 6-day compared to an average of 67 percent in the 3-day cycle treatments. Fresh meats, fresh milk, and eggs were the foods most desired or craved. Of the 15 subjects mentioning fresh meat, 11 specified steak or hamburgers, items usually grilled.

Most subjects (77 percent) recommended that shrimp be taken out of the ration, and about one-fifth recommended deleting rice. Ten subjects "nominated" pea soup. Only those in the 6-day cycle treatment were served the beef drink, and almost half of these suggested that this item be omitted. No other food was recommended for exclusion by more than 10 persons in all 3 treatments. On the other hand, eggs and more vegetables were each suggested for addition to the ration by at least 10 persons.

Generally, subjects felt they had enough to eat. Forty-nine preferred the canned to the dehydrated components, only 1 the dehydrated, and the remaining 19 had no preference.

b. Personal Reactions. The subjects planning their own menus had a significantly ( $p < 0.05$ ) higher level of morale during the test than either of the preplanned-menu groups. The last two did not differ significantly from each other. No significant differences were found in general attitude toward the Army and in attitude toward participation in the test (Appendix C-2).

Seventy-five percent of the subjects, according to their own statements, consumed foods or beverages other than those issued during the test. The highest percentage was for treatment 2 (3-day, preplanned): 96 percent, significantly higher ( $p < 0.05$ ) than for the other 2 treatments which did not differ significantly from each other. The foods most frequently eaten were coffee, soda pop, candy bars, and beer. Most of the unauthorized consumption occurred during 1 or 2 binges and mainly toward the end of the test. A few individuals accounted for most of each unauthorized item. The amount of stated unauthorized consumption averaged 9 calories per man per meal in treatments 1 and 2, and 2 calories in treatment 3. That unauthorized consumption did occur tends to lower confidence in the consumption-preference data. The most restrictive treatment was associated with the most "cheating."

Most subjects were either "certain" or "somewhat certain" that others cheated. Whether this belief had an objective basis or whether it was only a rationalization in support of their own cheating (i.e., "If others cheat, why shouldn't I?") could not be determined.

#### Basic Preference and Consumption Data for Individual Foods

Quantification. The means for preference and consumption was calculated by food, treatment, and cycle. The successive categories of the hedonic scale were assigned the values 1 to 9 (4), and the data then treated quantitatively.

Evaluation by Subjects. For most foods, not every subject indicated his preference or consumption on all cycles. Sometimes the failure was due to error, sometimes to absence from an entire meal at which the food was served. These individuals probably liked the food the least or were the most adversely affected by repetitive diets. To exclude their responses from the cycle on which their ratings were not available could only be misleading since the consumption and preference averages would be spuriously increased. This "self-selection" of being absent or not rating might mask downward trends in preference and consumption over a period of time, since those who do not like a food are the least likely to be represented in the averages. Siegel and Pilgrim (6) have presented supporting empirical evidence. The biasing effect might best be reduced by the exclusion of subjects from all cycles if at least one is missed. By the same reasoning, this exclusion would tend to raise the level of ratings by biasing it upwards for all cycles. However, this latter biasing is not considered as serious as the other because interest is focused on the trend of preference and consumption, not on the level of preference and consumption per se.

Accordingly, if a subject failed to indicate preference for or consumption of a food, none of his preference and consumption values were used in the calculations for any cycle. The exception occurred when a subject ate none or almost none and did not give a preference rating. Then, this mean rating was taken as the average rating of the food by those in the same treatment who also ate none or almost none, provided that one of the following criteria was met:

- a. The number who did rate was 9 or more.
- b. The number who did rate, if less than 9, was at least as large as the number who did not rate.

This correction procedure tends to minimize the upward bias which would have resulted by eliminating those who ate none or almost none and logically did not rate.

Before a food was considered for tabulation and analysis, there had to be a minimum of 15 preference and consumption values per cycle per treatment. In some cases, by eliminating one or two cycles, this minimum number could be maintained. Hence, occasionally all the data from some cycles was discarded and missing entries in the tables are indicative of the cycles so affected.

#### SUMMARY OF RESULTS

No general decline or increase in consumption or preference over time was evident, and only a limited number of foods demonstrated the same trend in all 3 treatments. For treatment 1, consumption of 29 percent of the foods increased by at least 3 percent, 65 percent decreased, and 6 percent remained the same. The comparable percentages for treatment 2 were 28, 45, and 27 percent; and for treatment 3 they were 31, 40, and 29 percent. In treatment 1, preference for 42 percent of the foods increased by at least the minimal amount of 0.1 scale point, 35 percent decreased, and 23 percent showed no change. The analogous figures for treatment 2 were 41, 45, and 14 percent; and for treatment 3 they were 38, 43, and 19 percent. If the percentages of no change are equally divided between increases and decreases, then the similarities among treatments become more apparent. About 40 percent of the foods increased in consumption, and about 50 percent increased in preference.

In the succeeding paragraphs, only those foods, where the net change in consumption was at least 10 percent of preference, will be discussed.

Juices and Fruits. Most foods in this group showed no systematic trends. The levels of consumption, and more so of preference, were high, with only the fruit compote and dehydrated apricots having over-all mean ratings of less than 6.0. Consumption of orange-grapefruit blend and pineapple declined moderately in treatment 1, and preference for the former dropped in treatment 3. Treatment 3 had a higher initial preference so that the drop may have been a "regression

toward the mean" phenomenon. Preference for fruit compote increased for treatment 3, and preference for dehydrated orange juice increased for treatment 2. Canned apricots were higher in level of preference and consumption than were the dehydrated, but there were practically no differences between canned and dehydrated orange juice.

Potatoes and Starches. Average consumption of all items within this group was about two-thirds despite the fairly high level of ratings. In view of the large number of calories provided in the menus, nonconsumption of the starches is a reasonable and convenient way of limiting intake. Average preference (over all cycles) was less than 6.0 for only one food, steamed rice, and this occurred only for treatment 2. In this treatment, rice was served with shrimp, the lowest rating main dish. The low acceptance of shrimp may have affected evaluation of its accompaniment. In treatment 3, rice was served with turkey as well as with shrimp, and hence was not as adversely affected as the rice was in treatment 2. Potato sticks markedly increased in consumption in the two treatments for which data are available; an upward trend in preference is also suggested. Macaroni and the cereal bar declined about 13 percent in consumption for treatment 3.

Soups. Pea soup consistently dropped in acceptability in all 3 treatments. The level of consumption and preference was particularly low in the 3-day, pre-planned treatment. Consumption of vegetable soup declined 13 percent and tomato soup declined about 17 percent for treatment 1. The beef drink was the least consumed and second least liked of all foods served in treatment 3. During the course of the experiment its consumption dropped from a first-half average of 33 percent to a second-half average of 17 percent. Likewise, preference declined by 0.8 scale point.

Candies and Desserts. Preference and consumption was initially high for these items and, if anything, tended to increase. Preference for raisins in treatment 1 improved, and both preference and consumption increased for butter-scotch pudding in treatment 2 and chocolate drops in treatment 1. Preference for the chocolate caramel bar rose in treatment 2. In treatment 3, consumption of chocolate fudge bar, jelly sandwich, and fruitcake went up, while the consumption of the orange nut roll declined. Preference for the jelly sandwich and the pecan roll also increased for this treatment. It may be concluded that candies and desserts present no problems in monotony.

Bread and Crackers. Preference for the canned bread and crackers remained fairly constant among all treatments, but consumption declined by about 16 percent for treatment 1. Except for the ratings of bread by those in treatment 2, average preference was never less than 7.0 in any cycle.

Vegetables. Consumption of corn increased in treatment 3, the only treatment in which it was served. Average preference for this item was 7.5. Green beans were also a well liked item, the average ratings per treatment being 7.9, 7.4, and 7.6. Only for treatment 2 was there a drop in consumption as large as 10 percent. Peas had an average rating of 7.2, and consumption declined by about 10 percent in treatment 3.



Margarine and Jelly. Preference for these 2 items averaged over 7.5 for each treatment, with little or no change over a period of time. Consumption of margarine dropped slightly for treatment 1, and consumption of jelly increased slightly for treatment 3.

Beverages. Milk, for a reason not readily apparent, had unusually low consumption and preference values for treatment 2, and both indices declined further over time. This treatment also showed initially lower consumption and preference for cocoa, and preference for this item dropped further. Treatment 2 also showed decreases in consumption and preference for coffee drink though not for the chocolate drink. Which is the most preferred high-calorie, high-protein beverage, the coffee drink or the chocolate drink, is not clear. Those in treatment 2 tended to prefer the former (ratings of 6.3 vs. 5.9), while those in treatment 3 the latter (7.3 vs. 5.0).

Main Dishes. Since the main dish is usually the course which most determines the over-all satisfaction with a meal, each item will be discussed in turn:

a. Ham and Eggs (canned).--This food served only in treatment 3 showed that preference increased by 0.5 scale point over a period of time. The decrease of about 10 percent in consumption is almost solely attributable to the low consumption on the last cycle, with no concomitant change in preference.

b. Chicken (canned).--The 10 percent increase in consumption in treatment 3 primarily reflects the low consumption during the first cycle. Consumption during the remaining cycles was fairly constant.

c. Sliced Ground Beef with Tomato Gravy (dehydrated).--No changes in preference or consumption were apparent.

d. Turkey (canned).--The only trend was for consumption to decrease by about 10 percent for treatment 1.

e. Macaroni and Cheese (dehydrated).--This item, served only in treatment 3, showed about a 33 percent drop in consumption and about a 1.4 drop in preference.

f. Prefried Bacon.--The second-half preference in each treatment was at least 7.1. Treatment 2, which had an initial low preference, showed a better liking over a period of time for this item. Consumption dropped 10 percent for treatment 1.

g. Beef and Potato Hash (dehydrated).--For treatment 2 preference and consumption of this item was initially lower than in other treatments and dropped even further. For treatment 1, on the other hand, preference increased, the second half being an average of 7.4. Treatment 3 maintained a rating of about 6.0 throughout the test and an average consumption of about 60 percent.

h. Pork Steak (canned).--Pork steak, available only in treatment 3, was one of the highest rated and most consumed main dishes, and maintained its high status throughout the test.

i. Chicken and Gravy (dehydrated).--A drop in consumption was evident, 20 percent in treatments 1 and 2, and 10 percent in treatment 3. Despite the rather high first-half preferences (7.8, 7.6, 7.4), the decline in preferences was 0.8, 1.0, and 0.3 scale points for the 3 treatments. The curves of preference suggest that there would be a further drop with continued usage.

j. Beefsteak (canned).--Consumption dropped by approximately 17 percent in treatment 1, and about 10 percent for treatment 3, but no appreciable changes in preference were apparent. Never did consumption fall below 70 percent, and only in 1 cycle in 1 treatment did the average ratings of a treatment fall below 7.0.

k. Peanut Butter Sandwich.--Only treatment 3 was served this item. There was no evidence that acceptance changed.

l. Spaghetti with Meat and Tomato Sauce (canned).--In treatment 1, consumption declined by about 10 percent and preference 0.4 scale point, but no changes were evident in other treatments.

m. Fried Ham (canned).--Consumption dropped in all 3 treatments from 10 to 17 percent and preference by 0.4 scale point in treatments 1 and 3.

n. Beef and Gravy (dehydrated).--Only in treatment 1 were the high initial ratings maintained, with an over-all average of 8.0. The ratings for treatment 2 declined by 0.5 scale point, and for treatment 3 by 0.4 scale point. Consumption in treatment 2 also dropped by about 10 percent, but not significantly for treatment 3.

o. Tuna Fish (canned).--No changes in consumption or preference were apparent in treatment 3, the only treatment receiving this food. Ratings averaged 7.3, consumption 96 percent.

p. Shrimp and Tomato Sauce (dehydrated).--After their first experiences with this food, the men in treatment 1 often refused to place this item on the menu so that consumption and preference values for this treatment are not available. In the remaining 2 treatments, average consumption during any cycle was never greater than 33 percent nor the average ratings greater than 3.7. From any viewpoint, this item is unacceptable, both initially and after experience.

q. Chicken and Noodles (canned).--This food, available only in treatment 3, was one of the best accepted foods with an average rating of 8.0 and average consumption of 97 percent.

The evidence, as shown by the answers in the summary of responses and by examination of the subjects, limited as it is, suggests that the dehydrated foods are more likely to be grouped under monotony than the canned. For example, 2 types of canned chicken and 1 type of dehydrated chicken were served in each cycle to treatment 3. Both canned types maintained their high acceptability, but the dehydrated did not. Inspection of other canned vs. dehydrated main dishes tends to confirm this suggestion.

### Preference for the Meal-as-a-Whole

Despite inconsistent trends and levels of consumption and preference among treatments for individual foods, the ratings of the meal as a whole lend further support to the previous evidence that the self-planning treatment had more favorable attitudes toward the dietary than did the preplanned treatment on the same cycle length. Subjects were asked to indicate their preference for each meal as a whole. The ratings by treatments 1 and 3 were practically identical, those by treatment 2 about 0.7 scale point lower. Thus, satisfaction with a dietary in general and the meal-as-a-whole in particular may not be strongly related to satisfaction with the individual components.

### CONCLUSIONS

Interpretation of the results must be tempered by the consideration that unauthorized consumption might have obscured the preference and consumption trends and might have reduced many differences between experimental treatments. Accordingly, the interpretations offered must be considered suggestive or tentative.

The over-all satisfaction with the dietary and consumption of, and preference for, most foods were higher than was expected on the basis of other tests of individual components and studies of monotony. One might anticipate that unauthorized consumption would lead to decreased consumption of scheduled foods. Generally, consumption did not decline, suggesting that the unauthorized foods were of little importance, increased the attractiveness of the other foods, or were supplemental to, rather than substitutes for, the authorized ones. On the other hand, unauthorized foods should have their greatest effect in bringing about decreased acceptability of the least preferred foods, a possibility implying that the differences between foods may even be accentuated.

The facts that the subjects were volunteers, were treated courteously, and were promised a reward for their participation probably were also conducive to favorable attitudes.

Over-all satisfaction appeared greater among those who planned their own 3-day menu cycles than among those who were served preplanned menus. The superiority of this method as applied to the individual foods could not be demonstrated. Inspection of the consumption and preference data suggests that most of the variation among foods can be attributed more to the differences in initial acceptability than to differences in cycle length or type of planning. It appears that the general reactions of the subjects to the test were not necessarily related to their reactions toward specific items. The 3-day cycle, preplanned treatment had a less favorable attitude and evaluation of the dietary, but no clear-cut corresponding loss in acceptability of the individual foods was apparent.

For some foods, the trends were not always consistent from treatment to

treatment. What were some of the possible reasons? First, within any treatment the behavior of an individual was not independent of the behavior of others in his group. One or more dominant individuals could affect the attitudes and other reactions of the majority. Similarly, differences in skill of preparation might show up as differences among subgroups and treatments. Despite random assignment of subjects to treatments, these and other "group effects" could still be expected to occur. Statistically and experimentally, the responses were not independent and no rigorous method is available to take the undetermined degree of dependence into account.

Second, the menu combinations differed from treatment to treatment, and, for treatment 1, from cycle to cycle. Certainly, the "combination effects" could be separated neither from the initial differences among subjects in the different treatments nor from the main experimental variations themselves. Nevertheless, the levels of consumption and preference should be useful in evaluating the relative acceptability of items and their relative proneness toward monotony. The differences between treatments can provide a rough estimate of the variability of the levels of consumption and preference.

Future research on repetitive diets should impose more severe restrictions on the subjects than were observed in this experiment. Not only was the quality of most foods high to begin with, but more than one processing method was represented. The availability of both dehydrated and canned foods might have offered sufficient variety in flavor and texture to offset the availability of just a limited number of items. A fruitful investigation would be a 3-way comparison of an all-canned, an all-dehydrated, and a mixed dietary. Initial preference and number of different foods would, of course, have to be equated.

Finally, the variable of self-planning shows promise of being a method for increasing satisfaction with the food. The subjects demonstrated both the desire and the ability to do their own planning. Whether cooperation required in menu planning would have carryover effects to other situations involving teamwork can best be explored in naturalistic field situations. A drawback of self-planning is that the men might discard certain foods entirely, a major reason for the incomplete data from treatment 1.

## SUMMARY

The over-all satisfaction with a 3-day, self-planned dietary was at about the same level as a 6-day, preplanned (by others) dietary over 24 days. Both of these dietaries appeared superior to the shorter, preplanned dietary. This difference was not necessarily reflected in differences between, and changes in, acceptability of individual foods. A majority of subjects stated that they had consumed some foods and beverages not authorized or scheduled. Although the extent of such unauthorized consumption was a small fraction of the total amount eaten during the test, firm conclusions on the absolute drops in consumption and preference are difficult. Nevertheless, the data on the individual foods are suggestive of foods which would be affected most adversely by repetitive serving.

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# APPENDIX A

## Number of Times Each Food was Served in Each Experimental Treatment

<u>Food</u>	<u>Number of Times Served per Cycle</u>		<u>Food Type Code</u>
	<u>Treatments 1 &amp; 2 (Three-Day Cycles)</u>	<u>Treatment 3 (Six-Day Cycle)</u>	
Tomato juice	0	1	C, Com
Orange-grapefruit blend	1	1	C, Com
Fruit compote	1	1	D, Mil
Grape juice	1	1	C, Com
Apricot nectar	0	1	C, Com
Orange juice, canned	1	1	C, Com
Pineapple juice	0	1	C, Com
Apple juice	0	1	C, Com
Orange juice, dehy.	1	1	D, Mil
Apricots, canned	1	1	C, I
Applesauce	0	1	D, Mil
Pears	0	2	C, I
Pineapple	1	1	C, I
Apricots, dehy.	1	1	D, Mil
Peaches	1	1	C, I
Fruit cocktail	2	1	C, I
Grapefruit juice	0	1	D, Mil
Mashed potatoes	2	2	D, Com
Rice	1	2	D, Mil
Potato sticks	1	2	C, Mil
Oatmeal	1	1	D, Mil
Macaroni	0	1	D, Mil
Cereal bar	0	1	D, Mil
Vegetable soup	1	1	C, Com
Cream of mushroom soup	0	1	C, Com

NOTES: 1. Such staples as coffee, margarine, and sugar are not included in the above list.

2. Food type code: C - Canned  
 Com - Purchased commercially (national brand)  
 D - Dehydrated  
 E - Experimental food  
 I - Component of In-Flight ration  
 Mil - Military sources  
 P - Prepared as needed from canned ingredients

## APPENDIX A (Cont'd)

## Number of Times Served per Cycle

<u>Food</u>	<u>Treatment 1 &amp; 2</u> <u>(Three-Day Cycles)</u>	<u>Treatment 3</u> <u>(Six-Day Cycle)</u>	<u>Food Type</u> <u>Code</u>
Pea soup	1	1	D, Mil
Beef soup	0	1	C, Com
Chicken rice soup	0	1	D, Mil
Tomato soup	1	1	C, Com
Beef drink	0	1	E, P
Poundcake	1	1	C, I
Cranberry sauce	0	1	C, Com
Chocolate chip cookies	0	1	Com
Peppermint drops	1	1	Com
Pecan roll	1	1	C, I
Chocolate fudge bar	1	1	Com
Peanut butter snack	1	1	C, Mil
Butterscotch pudding	1	1	D, Com
Jordan almonds	1	1	Com
Orange-nut roll	0	1	C, Mil
Chocolate caramel bar	1	1	Com
Sour ball candies	0	1	Com
Caramels	0	1	Com
Jelly sandwich	0	1	Com
Chocolate pudding	0	1	D, Com
Fruit cake	1	1	C, Mil
Sugar wafers	1	1	Com
Toffee	0	1	Com
Chocolate drops	1	0	Com
Raisins	1	1	Com
Vanilla wafers	0	1	Com
Macaroons	0	1	Com
Dates	0	1	Com
Bread	8	17	C, E
Crackers	3	7	E
Corn	0	1	C, Com
Beans, green	1	1	C, Com
Peas	0	1	C, Com
Milk	4	9	D, Com
Cocoa	2	4	Com



## Number of Times Served per Cycle

<u>Food</u>	<u>Treatments 1 &amp; 2</u> <u>(Three-Day Cycles)</u>	<u>Treatment 3</u> <u>(Six-Day Cycle)</u>	<u>Food Type</u> <u>Code</u>
Coffee drink	2	1	C, E
Chocolate drink	1	2	C, E
Ham & eggs	0	1	C, I
Chicken, solid, canned	0	1	C, I
Ground beef/tomato gravy	0	1	D, Mil
Turkey	1	1	C, I
Macaroni & cheese	0	1	D, Mil
Prefried bacon	1	1	C, Mil
Beef & potato hash	1	1	D, Mil
Pork steak	0	1	C, I
Chicken & gravy	1	1	D, Mil
Beefsteak	1	1	C, I
Peanut butter sandwich	0	1	Com
Spaghetti/meat & tomato sauce	1	1	C, I
Ham, fried	1	1	C, I
Beef & gravy	1	1	D, Mil
Tuna fish	0	1	C, I
Shrimp & tomato sauce	1	1	D, Com
Chicken & noodles	0	1	C, I

# APPENDIX B-1

## THREE-DAY MENU CYCLE

Breakfast	Dinner	Supper	Evening Snack
<b>First day</b>			
Orange juice, dehydrated Ham, fried Apricots, canned Bread Jelly Milk Coffee Cream, sugar	Grape juice, canned Shrimp/tomato sauce Rice Bread Margarine Chocolate drink Jordan almonds Peppermint drops	Tomato soup Crackers Beef and gravy Pineapple Potatoes, mashed Bread Margarine Pound cake Coffee, tea Cream, sugar	Candy bar Milk
<b>Second day</b>			
Orange juice, canned Prefried bacon Potato sticks Pecan roll Margarine Coffee Cocoa Cream, sugar	Fruit cocktail Chicken and gravy Potatoes, mashed Beans, green Bread Jelly Chocolate fudge bar Coffee, tea Cream, sugar	Pea soup Crackers Beefsteak Bread Margarine Apricots, dehydrated Coffee drink Raisins	Fruit cake Milk Coffee, tea Cream, sugar
<b>Third day</b>			
Fruit compote Oatmeal Beef and potato hash Bread Margarine Milk Coffee Cream, sugar	Orange and grapefruit blend Turkey Peaches Bread Margarine Bitterscotch pudding Coffee drink	Vegetable soup Crackers Spaghetti/meat Fruit cocktail Bread Margarine Sugar wafers Coffee, tea Cream, sugar	Peanut-butter snack Cocoa Chocolate drops

# APPENDIX A-2

## SIX-DAY MENU CYCLE

Breakfast	Dinner	Supper	Evening Snack
<b>First day</b>			
Tomato juice Ham and eggs Apple sauce Bread Margarine Milk Coffee Cream, sugar	Vegetable soup Crackers Chicken, solid, canned Pears Bread Margarine Pound cake Cocoa	Orange-grapefruit blend Ground beef w/tomato gravy Potatoes, mashed Corn Bread Margarine Cranberry dessert Coffee, tea Cream, sugar	Chocolate chip cookies Peppermint drops Milk
<b>Second day</b>			
Fruit compote Pecan roll Margarine Coffee drink Cocoa	Grape juice Turkey Rice Beans, green Bread Jelly Apricots, canned Cream, sugar	Cream of mushroom soup Macaroni and cheese Puffed bacon Bread Margarine Chocolate fudge bar Coffee Cream, sugar Crackers	Peanut-butter snack Milk
<b>Third day</b>			
Grapefruit juice Beef and potato hash (without onions) Bread Jelly Milk Coffee Cream, sugar	Pea soup Crackers Pork steak Fruit cocktail Bread Margarine Butterscotch pudding Coffee, tea	Apricot nectar Chicken and gravy Potatoes, mashed Pineapple Bread Margarine Raisins Jordan almonds Coffee, tea Cream, sugar	Orange nut roll Milk

# SIX-DAY MENU CYCLE (Cont'd)

Breakfast	Dinner	Supper	Evening Snack
Fourth day			
Orange juice, canned	Beef soup	Chicken rice soup	Jelly sandwich
Beef steak	Crackers	Crackers	Milk
Potato sticks	Peanut-butter sandwich	Spaghetti w/meat	
Bread	Bread	Anricots, dehydrated	
Margarine	Margarine	Bread	
Milk	Candy bar	Margarine	
Coffee	Chocolate drink	Caramels	
Cream, sugar	Sour ball candies	Coffee, tea	
		Cream, sugar	
Fifth day			
Pineapple juice	Tomato soup	Apple juice	Sugar wafers
Oatmeal	Crackers	Tuna fish	Toffee
Milk	Beef and gravy	Potato sticks	Coffee, Tea
Ham, fried	Macaroni	Bread	Cream, sugar
Bread	Peas	Jelly	
Jelly	Bread	Fruit cake	
Cocoa	Margarine	Coffee drink	
Cream, sugar	Chocolate pudding		
	Coffee, tea		
	Cream, sugar		
Sixth day			
Orange juice, dehydrated	Fruit cocktail	Beef drink	Macaroons
Cereal bar	Shrimp and tomato sauce	Crackers	Dates
Prefried bacon	Rice	Chicken and noodles	Cocoa
Peaches	Peanut-butter sandwich	Bread	
Bread	Bread	Jelly	
Margarine	Margarine	Pears	
Milk	Chocolate drink	Vanilla wafers	
Coffee		Coffee	
Cream, sugar		Cream, sugar	

# APPENDIX C-1

## Summary of Responses to Final Questionnaires (N = 23 per experimental treatment)

### PART I. Food Evaluation

		Experimental treatment:		
		I	II	III
A.	How satisfactory do you think the rations would be for two months' continuous use in the field?			
	1. Extremely satisfactory	1	0	1
	2. Very satisfactory	6	2	6
	3. Moderately satisfactory	9	9	12
	4. Somewhat satisfactory	6	7	3
	5. Not satisfactory	1	3	1
	6. Definitely unsatisfactory	0	2	0
	AVERAGE	3.0	3.7	2.9
B.	If you had a choice, would you rather:			
	Take out some foods and increase the quantity of other foods	14	21	19
	Leave the ration as it is	9	2	4
C.	What foods, if any, would you recommend taking out of the rations you consumed during the test? (Given by at least 10 subjects in all conditions)			
	Shrimp		53	
	Rice		13	
	Beef drink (Treatment III only)		11	
	Pea soup		10	
D.	Perhaps there are some foods that you think should be in this type of ration, but weren't included. What foods would you recommend putting into future rations of this type? (Given by at least 3 subjects in all conditions)			
	Eggs		14	
	More vegetables		8	
	Ham and eggs		3	
	Cheese		3	

APPENDIX C-1 (Cont'd)

		Experimental Treatment		
		I	II	III
E.	What do you think is the longest time one should expect a soldier to eat this ration and nothing else?			
	1. Less than one week	0	2	1
	2. From one to two weeks	0	1	2
	3. From two weeks to one month	6	9	11
	4. From one month to three months	12	10	7
	5. More than three months	5	1	2
	AVERAGE	4.0	3.3	3.3
F.	Did you have enough to eat?			
	More than enough	4	1	1
	About the right amount	17	16	19
	Too little	2	6	3
G.	Which foods did you generally like better?			
	Canned better	15	13	16
	Dehydrated better	0	0	1
	About the same	8	5	6
H.	During the test, did you develop any strong desires or cravings for foods that weren't available to you?			
	Yes	16	15	5
	No	7	8	18
	If you answered yes, what were these foods that you desired or craved? (Given by at least 3 subjects in all conditions)			
	Meats			
	Steak	7		
	Hamburger	4		
	Fresh meats in general	4		
	Fresh milk		12	
	Eggs		10	
	Ice cream		5	
I.	How much longer do you think you could live on this ration only without disliking it extremely?			
	1. No longer	1	4	0
	2. Up to a week longer	1	1	1
	3. One week to two weeks longer	5	4	3
	4. Two weeks to a month longer	6	4	7
	5. One month to two months longer	7	9	8
	6. More than two months longer	3	1	4
	AVERAGE	4.1	3.7	4.5

# APPENDIX C-2

## PART II. Personal Reactions

		Experimental Treatment:		
		<u>I</u>	<u>II</u>	<u>III</u>
A.	In your own words, describe how you feel about this test - its importance, the way you were treated, your ideas and interests, your good and bad experiences.			
(Summary of responses is not presented here)				
B.	In general, how high was your morale during this test?			
	1. Extremely high	2	1	1
	2. Very high	10	4	5
	3. Moderately high	5	6	9
	4. Somewhat high	5	6	7
	5. Somewhat low	1	4	1
	6. Moderately low	0	2	0
	7. Very low	0	0	0
	8. Extremely low	0	0	0
	AVERAGE	2.7	3.6	3.1
C.	Considering your experiences with and knowledge of the Army, how would you rate your general attitude toward the Army?			
	1. Extremely favorable	2	1	0
	2. Very favorable	4	4	2
	3. Moderately favorable	7	5	12
	4. Slightly favorable	6	5	5
	5. Slightly unfavorable	1	3	0
	6. Moderately unfavorable	0	2	0
	7. Very unfavorable	3	1	3
	8. Extremely unfavorable	0	2	1
	AVERAGE	3.5	4.1	3.9
D.	How do you feel about participating in this test of foods?			
	1. Very <u>happy</u> to participate	17	12	14
	2. Somewhat <u>happy</u> to participate	6	8	7
	3. Don't particularly care one way or the other	0	3	2
	4. Somewhat <u>unhappy</u> to participate	0	0	0
	5. Very <u>unhappy</u> to participate	0	0	0
	AVERAGE	1.3	1.6	1.5

APPENDIX C-2 (Cont'd)

Experimental Treatment:

I      II      III

- E. Many people would find it difficult to eat no other food provided them during this test. During your free time, you might have consumed some food or beverage not issued, perhaps without your being aware of it until you finished. When you answer the next question, bear in mind that your truthful answer - no matter what it is - will not be held against you or anyone else in any way. It is of the utmost importance that your reply be completely honest in order that the results be of most use to the Army. Remember, no one is perfect.

Did you consume during this test any food or beverage other than water and the foods issued you?

Yes, I did eat other foods or beverages	14	22	16
No, I <u>did not</u> eat other foods or beverages	0	1	7

If you answered yes, what did you eat or drink, approximately how much, and when?

The most frequently given items were coffee, soda pop, candy bars, beer. Most unauthorized consumption occurred toward the end of the test, and a few individuals accounted for most of the quantity of each unauthorized item.

- F. Do you believe some of the others participating in this test consumed food or beverages not issued them?

Yes, many did	4	7	4
Yes, a few did	11	13	16
No, none did	7	3	2
No answer	1	0	0

How certain of your answer are you?

Very certain	13	13	13
Somewhat certain	10	7	6
Not too certain	0	1	4

- G. Which of the following best describes your physical condition:

a. At the start of the test?

Excellent	13	0	7
Good	7	13	13
Fair	2	1	2
Poor	0	0	1
No answer	1	0	0



APPENDIX C-2 (Cont'd)

		Experimental Treatment:		
		<u>I</u>	<u>II</u>	<u>III</u>
b.	During the test:			
	Excellent	0	6	3
	Good	11	12	17
	Fair	3	4	2
	Poor	0	0	1
	No answer	0	1	0
c.	At the end of the test:			
	Excellent	0	5	5
	Good	10	12	14
	Fair	2	5	2
	Poor	1	0	2
	No answer	1	1	0

<p>WADD TR 60-750</p> <p>Quartermaster Food and Container Institute for the Armed Forces, Chicago, Illinois. EFFECTS OF REPETITIVE EATING OF LIMITED GROUPS OF FOOD ITEMS ON FOOD ACCEPTANCE. December 1960. 28p. incl. 7 refs. (Proj. 7164; Task 71833) (MIPR No. 33(616)59-19 Unclassified Report</p> <p>The effects of the type of menu planning, and the number of different foods on food preferences and consumption are discussed. Seventy-two volunteers were assigned randomly to three 24-day feeding treatments: (a) 3-day, preplanned, fixed-menu cycle, all meals in the same sequence; (b) 6-day, preplanned,</p> <p>( over )</p>	<p>UNCLASSIFIED</p> <p>I. Wright Air Development Division, Aerospace Medical Laboratory, Wright-Patterson Air Force Base, Ohio II. MIPR No. 33(616)59-19</p> <p>UNCLASSIFIED</p>
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<p>fixed-menu cycle, same foods as above plus an approximately equal number of new foods; and (c) 3-day cycle, same foods as (a) but, after first 3 days, men planned their own menus. The foods, mainly canned or dehydrated, were from military and commercial sources. Experimental items, including a high-protein beef drink, high-calorie, high-protein chocolate drink, and coffee drink, were also served. The over-all satisfaction with (b) and (c) was about equal and higher than with (a).</p>	<p>UNCLASSIFIED</p> <p>UNCLASSIFIED</p> <p>UNCLASSIFIED</p>	<p>fixed-menu cycle, same foods as above plus an approximately equal number of new foods; and (c) 3-day cycle, same foods as (a) but, after first 3 days, men planned their own menus. The foods, mainly canned or dehydrated, were from military and commercial sources. Experimental items, including a high-protein beef drink, high-calorie, high-protein chocolate drink, and coffee drink, were also served. The over-all satisfaction with (b) and (c) was about equal and higher than with (a).</p>	<p>UNCLASSIFIED</p> <p>UNCLASSIFIED</p> <p>UNCLASSIFIED</p>

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<p>WADD TR 60-750</p>	<p>The effects of the type of menu planning, and the number of different foods on food preferences and consumption are discussed. Seventy-two volunteers were assigned randomly to three 24-day feeding treatments: (a) 3-day, preplanned, fixed-menu cycle, all meals in the same sequence; (b) 6-day, preplanned,</p>	<p>UNCLASSIFIED</p>	<p>UNCLASSIFIED</p>	<p>The effects of the type of menu planning, and the number of different foods on food preferences and consumption are discussed. Seventy-two volunteers were assigned randomly to three 24-day feeding treatments: (a) 3-day, preplanned, fixed-menu cycle, all meals in the same sequence; (b) 6-day, preplanned,</p>	<p>UNCLASSIFIED</p>	<p>I. Wright Air Development Division, Aerospace Medical Laboratory, Wright-Patterson Air Force Base, Ohio II. MIPR No. 33(616)59-19</p>
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